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Tests
T-2

Physics 30X
1968

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HIGH SCHOOL AND UNIVERSITY MATRICULATION

EXAMINATIONS BOARD

DEPARTMENTAL EXAMINATIONS, 1968

PHYSICS 30X

Time — 2 hours.

Total Possible Mark — 142.

Questions 1 to 52 are multiple choice questions and are valued at two marks each.

Your score in this section is the number of correct answers you give. If a question seems to be too difficult, make the most careful guess you can, rather than waste time puzzling over it.

Note — Mathematical tables will be supplied by the presiding examiner.
Slide rules may be used.

Use the following constants where they are required:

$g = 10\ \text{m/sec}^2$
1 calorie = 4.2 joules
1 coulomb = 6.24×10^{18} elem. ch.
1 volt = 1.6×10^{-19} joules/elem.ch.

Write your name and school in the spaces provided on the separate answer sheet but do not write your name on this booklet.

Finished work in this booklet must be done in pencil or blue or black ink (pen or ballpoint).

DO NOT FOLD EITHER THE ANSWER SHEET OR THE TEST BOOKLET.

Place your answer sheet **BEHIND** the test booklet and **INSERT BOTH IN THE SAME ANSWER ENVELOPE** in such a way that the **UPPER LEFT-HAND CORNER OF THE BOOKLET** (candidate's number) shows through the **SLASHED CORNER** of the answer envelope.

[illegible] SURE TO SEAL THE ENVELOPE.

Machine Score
Booklet Score
TOTAL

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B HIST

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Questions 1 - 60 i re to record your answer on
the separate answ question has four suggested
answers. Select t arate ANSWER SHEET, as
shown in the exa

EXAMPLE

A body moves at t
4.0 m/sec. How f
travel in 10 sec?

ANSWER SHEET

B ▬ C ☐ D ☐ E ☐

SREGARD COLUMN "E"
N THE ANSWER SHEET

You are to use a ur answers on the ANSWER
SHEET. Make ce black and that they do not
extend beyond th about an answer, be sure to
erase your first one answer marked for each
question. Be sure ur answer sheet.

1. Photographs of a
a uniform rate a
measuring scale
rate of 24 per sec
is observed to ch
3.0 cm from one picture to the
next its speed is

n/sec
/sec
m/sec
of these

2. The following measurements were given for a strip of metal: length = 3.0 m, width = 1.20 cm, thickness = 2.012 mm. Its volume determined from this data is correctly expressed as

2.
A. 7.24×10^{-2} cu m
B. 7.233×10^{4} cu m
C. 72 cu cm
D. 72.4 cu cm

3. The process of interpolation requires that

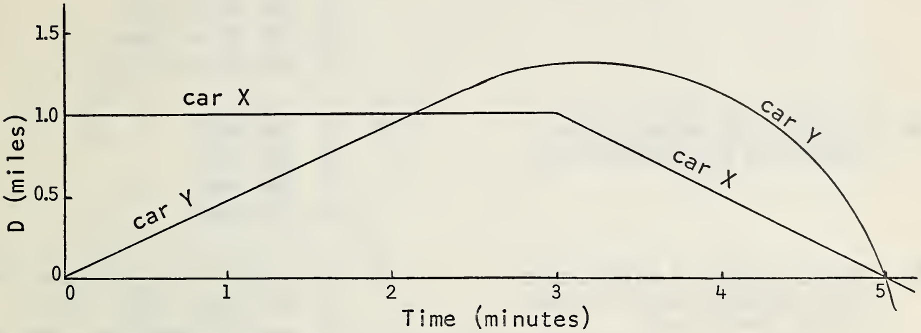
3.
A. a formula be developed from experimental data
B. relationships be predicted beyond the range of experimental data
C. additional relationships within the range of experimental data be estimated
D. some experimental data be rejected because it is not in agreement with the rest

FOR ROUGH WORK

(No marks given for work in this space)

Questions 4, 5 and 6 relate to the following information:

The motions of two cars X and Y are described by the graph below. The cars move along a straight road which runs north and south. Distance D, is measured north from a fixed reference point.



4. At the beginning of the time interval represented in the graph

4. A. car X is north of car Y
B. car X is going faster than car Y
C. car Y is standing still
D. the cars are side by side on the road

5. Two minutes after the start of the time interval

5. A. car Y is accelerating
B. car X and car Y are going at the same speed
C. car X is standing still
D. both cars are travelling northward

6. During the fifth minute of the time interval represented in the graph

6. A. car X travelled further than car Y
B. car X slowed down
C. car Y speeded up
D. both cars moved northward

FOR ROUGH WORK

(No marks given for work in this space)

Questions 7 - 10 relate to the following information.

An airplane which maintains an airspeed of 160 mph is to fly from point P to point Q which is 200 miles due south of P while a wind blows directly from the east at 80 mph.

Question	Answers
7. An airplane's heading should be	**7.** A. 60° E of South B. 30° E of South C. 30° W of South D. 60° W of South
8. Its speed with respect to the ground will be approximately	**8.** A. 140 mph B. 175 mph C. 160 mph D. 240 mph
9. The line traced on a flat map to show the path followed by the airplane should run	**9.** A. east of south first, then westward B. due south from point P C. west of south first, then eastward D. along a curved path to the east of a straight line joining P and Q
10. If the wind were not blowing the	**10.** A. groundspeed of the airplane would be less B. heading of the plane should still be the same C. airplane could make the trip in less time D. airplane would take more time to make the trip
11. The force, in excess of that required to overcome friction, needed to accelerate a 2000 kg automobile at a rate of 2.0 m/sec^2 is	**11.** A. 400 kg/sec^2 B. 4000 $kg\text{-}m/sec^2$ C. 4000 $newtons/sec^2$ D. zero

FOR ROUGH WORK

(No marks given for work in this space)

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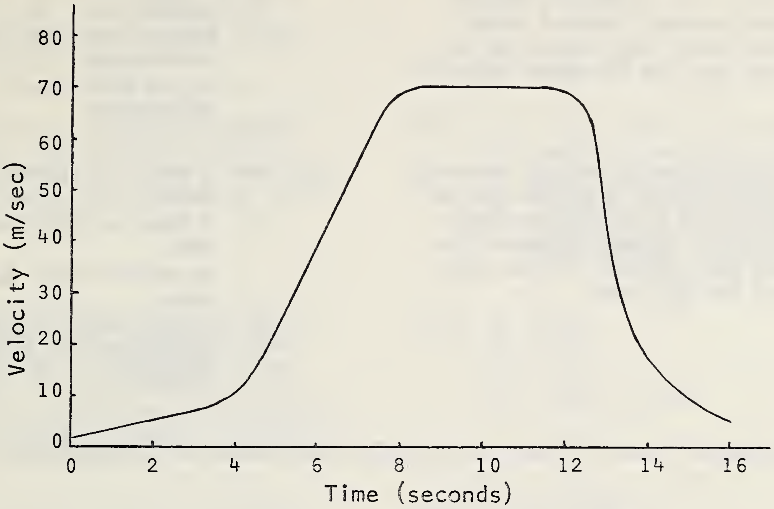
Questions 12 - 15 refer to the following graph and information.



The velocity-time graph represents the motion of a 3.0 kg mass moving in a straight line. Assume frictional forces are negligible.

12. The force acting on the object has its maximum value between	**12.** A. 0 and 4.0 sec B. 4.0 and 8.0 sec C. 8.0 and 12 sec D. 12 and 16 sec
13. The force acting on the object has its minimum value between	**13.** A. 0 and 4.0 sec B. 4.0 and 8.0 sec C. 8.0 and 12 sec D. 12 and 16 sec
14. The force acting at the 14 second mark is approximately	**14.** A. 26 newtons B. 45 newtons C. 3.0 newtons D. 225 newtons
15. The force acting at the 10 second mark is	**15.** A. 2100 newtons B. 210 newtons C. 21 newtons D. zero

FOR ROUGH WORK

(No marks given for work in this space)

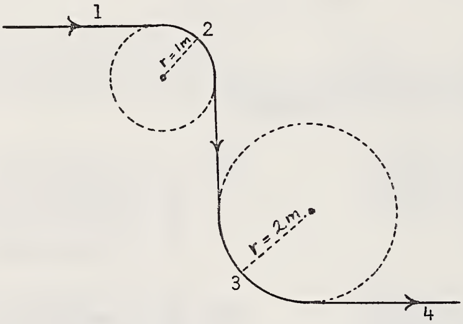
16. Two objects of the same size and shape but one having twice the mass of the other, are dropped simultaneously from a tower. They strike the ground at the same time, but the object with the

16. A. larger mass has the higher velocity
B. smaller mass has the higher velocity
C. larger mass has the lower acceleration
D. larger mass has a greater momentum

17. A ball is thrown vertically upwards and it remains in the air for 2.0 seconds. It is thrown vertically again and remains in the air for only 0.50 seconds. In the first case the ball rose

17. A. 2 times as high as in the second case
B. 4 times as high as in the second case
C. 16 times as high as in the second case
D. higher than in the second case but impossible to tell how many times higher

Questions 18 and 19 relate to the following diagram and information.



The solid line in the diagram represents the path of a particle moving at 3.0 m/sec on a horizontal surface.

18. The maximum acceleration of the particle occurs at position

18. A. 1
B. 2
C. 3
D. 4

19. The momentum of the particle is about the same at

19. A. position 1 and 2
B. position 2 and 3
C. position 3 and 4
D. all of the above

FOR ROUGH WORK

(No marks given for work in this space)

20. Mars has a mass 1/10 that of the earth and a diameter ½ that of the earth. The acceleration of a falling body near the surface of Mars is about

20. A. 0.5 m/sec^2
B. 25 m/sec^2
C. 4 m/sec^2
D. 2 m/sec^2

21. A block of metal is suspended from a spring balance first at the equator and then at one of the poles. The reading at the pole is

21. A. greater than at the equator
B. smaller than at the equator
C. equal to the reading at the equator
D. greater or smaller depending upon whether the reading is taken at the North or the South pole

22. Two frictionless carts initially at rest and in contact are driven apart by an expanding spring. They have speeds then of 5.0 cm/sec and 3.0 cm/sec respectively, in opposite directions. The ratio of their masses is

22. A. 3:5
B. 9:25
C. 1:8
D. none of these

23. An explosion blows a rock into three parts of equal mass. If the speeds of two of the pieces, after the explosion, are 10 m/sec and 20 m/sec respectively, the maximum speed of the third piece is

23. A. 10 m/sec
B. 15 m/sec
C. 20 m/sec
D. 30 m/sec

24. An automobile initially moving at 45 mph increases its speed to 90 mph. It is true to say

24. A. both its momentum and its kinetic energy will be doubled
B. both its momentum and kinetic energy will increase fourfold
C. the kinetic energy will double while the momentum will increase fourfold
D. the kinetic energy will increase fourfold while the momentum will double

FOR ROUGH WORK

(No marks given for work in this space)

25. A force of 12 newtons is applied to a 1.0 kg body for 0.5 sec. The impulse given to the body is

25. A. 12 newtons
B. 6 newtons
C. 6 newton-seconds
D. 12 newton-seconds

26. A 5.0 kg body is moving along a horizontal surface. A force of 30 newtons is then applied for 3.0 sec. The work done by the force is

26. A. 150 joules
B. 50 joules/sec
C. 90 newton-sec
D. not determinable with information given

27. A body initially at rest on a frictionless surface is given a kinetic energy of 40 joules by a force of 0.5 newtons. The distance the body travelled in gaining this amount of energy is

27. A. 80 m
B. 20 m
C. dependent on the mass of the body
D. not determinable with the information given

28. A 5.0 kg body falls vertically downwards near the surface of the earth. It loses 400 joules of potential energy. In losing this energy it fell

28. A. 800 m
B. 80 m
C. 8.0 m
D. 0.80 m

29. A body of mass 5.0 kg is moving at 8.0 m/sec for 3 sec. It has a kinetic energy of

29. A. 480 joules
B. 160 joules
C. 53.3 joules
D. 16 joules

30. A linear spring of unstretched length 1.0 m and having a force extension ratio of 12 newtons/m hangs vertically, supporting a 0.60 kg mass. The stretched length of the spring is

30. A. 21 m
B. 7.2 m
C. 1.5 m
D. 1.05 m

FOR ROUGH WORK

(No marks given for work in this space)

31. A linear spring is compressed to a length L_1 and stores 3.0 joules of energy. It is then compressed to a length L_2 and stores 4.0 joules of energy. The ratio $L_1 : L_2$ is

31.
A. 4 : 3
B. 3 : 4
C. 9 : 16
D. not determinable with information given

32. If a molecule of mass m and speed v hits a wall perpendicularly and rebounds directly back with a speed v, what is the impulse given to the wall?

32.
A. mv
B. m^2v^2
C. 2mv
D. mv^2

33. The pressure of an enclosed mass of gas is 1.0×10^5 newtons/m^2 and its temperature is 27° C. If the pressure is increased to 3.0×10^5 newtons/m^2, the gas temperature has risen to

33.
A. 81° C
B. 327° C
C. 627° C
D. 900° C

34. At 10° C the kinetic energy of center of mass motion of the molecules of an enclosed mass of gas is 12 joules. If the temperature rises to 20° C then this kinetic energy becomes approximately

34.
A. 12 joules
B. 24 joules
C. 120 joules
D. 240 joules

FOR ROUGH WORK

(No marks given for work in this space)

Questions 35 and 36 relate to the following information.

A six inch rod of unknown material rests upon an insulator. A grounded wire touches one end of it while an electrically charged sphere is held an inch away from the other end of the rod. First the ground wire is removed and after that the charged sphere is taken away. It is found that the rod then attracts a tiny neutral iron ball suspended on a thread and held near it. When the ground wire is touched to the rod again, the rod loses its ability to attract the iron ball.

35. The rod must have been

35.
A. a permanent magnet
B. a conductor of electricity
C. an electrical insulator
D. charged by self induction

36. If the rod had continued to attract the iron ball after being grounded the second time, the evidence would indicate that the rod must have been

36.
A. a permanent magnet
B. a conductor of electricity
C. an electrical insulator
D. charged by self induction

37. The tracks of alpha particles become visible in a cloud chamber because

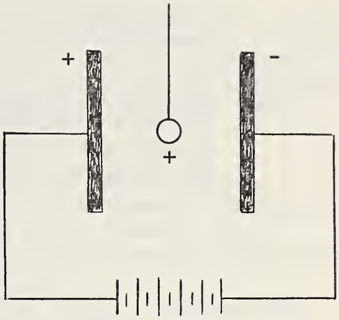
37.
A. alpha particles vaporize when they slow down
B. ions produced by the alpha particles are a source of light
C. alpha particles give off visible rays as they collide with droplets of vapor
D. vapor condenses around ions produced by the moving alpha particles

FOR ROUGH WORK

(No marks given for work in this space)

Questions 38 and 39 relate to the following information and diagram.

An electrically charged sphere hangs on a long string between two oppositely charged parallel plates as shown in the diagram. The charge on the plates is maintained by means of high voltage batteries connected to them.



38. The electrical force on the sphere can be increased by moving

A. it to the left
B. it to the right
C. the plates closer together
D. plates further apart

39. The work done by the electric field as it moves the sphere from its central position to one of the plates is proportional to the

A. potential difference which the batteries create between the plates
B. square of the amount of charge on the sphere
C. distance by which the plates are separated
D. area of the plates

40. The famous experiment performed by R. A. Millikan in which he observed the motion of charged oil drops in an electric field was designed to

A. prove Coulomb's law
B. show that electric fields were very strong
C. measure the strength of electric fields
D. show that an elementary unit of charge existed

41. The strength of the electric force field near the flat surface of a single large flat conducting charged plate

A. varies as the square of the distance from the plate
B. varies inversely as the distance from the plate
C. is independent of the distance from the plate
D. is directly proportional to the area of the plate

42. A charged particle is free to move under the influence of the electric field caused by two like charged spheres fixed in position. If the particle is not directly between the two spheres and is nearer one than the other, its path will be

A. along a line perpendicular to the straight line joining the centers of the two spheres
B. along a curved line
C. directly away from the nearer sphere
D. along a straight line which forms an acute angle with the line joining the centers of the two spheres

Questions 43 and 44 relate to the following information.

In an experiment to investigate the charge carried by ions in solution a student uses two copper electrodes immersed in a dilute solution of sulfuric acid.

43. In order to calculate the number of moles of copper ions that transfer charge the student uses the atomic mass of copper and the

43.
A. decrease in mass of the positive electrode
B. decrease in mass of the negative electrode
C. increase in mass of the negative electrode
D. decrease in mass of the positive electrode plus increase in mass of the negative electrode

44. The number of elementary charges that are transferred through the solution is readily found by determining the length of time during which flow of charge is constantly maintained and using it in a calculation also requiring a measurement of the

44.
A. volume of hydrogen produced
B. voltage across the electrodes
C. current through the circuit outside the solution
D. total number of copper ions transferred

45. A beam of electrons entering an electric field at right angles to the field will

45.
A. be deflected in the direction of the field so as to follow a curved path through the field
B. be deflected in a direction opposite that of the field so as to follow a curved path through the field
C. not be deflected
D. be deflected where it enters the field but follow straight path through the field

46. The direction of the magnetic field produced above a wire which is carrying a current due westward is

46.
A. upward
B. parallel to the current
C. southward
D. northward

FOR ROUGH WORK

(No marks given for work in this space)

47. The amount of force exerted on a charged particle by a magnetic field through which it moves depends on

47. A. whether the charge is positive or negative
B. the component of velocity of the particle at right angles to the field
C. the depth of the field measured at right angles to the field direction
D. the mass of the charged particle

48. In an experiment using a magnetic field to determine the mass of an electron, the strength of the magnetic field used and the potential difference used to accelerate the electrons must be known. In addition to these one must measure the

48. A. velocity of the electrons
B. radius of curvature of the electron path in the magnetic field
C. energy of the electrons that strike the anode
D. current used to produce the magnetic field

49. When a circular wire loop is rotated at a constant rate in a constant magnetic field so as to produce the greatest current, then the current produced in the loop will be

49. A. constant
B. greater than that produced by a rectangular loop of the same area
C. zero at some times
D. always in the same direction

50. When the magnetic flux through a loop of conducting wire is increasing at a uniform rate the resulting current induced in the loop is

50. A. zero
B. constant
C. proportional to the amount of flux through the loop
D. in the same direction as if the flux were decreasing

51. The source of all kinds of electro-magnetic radiation is

51. A. radioactive materials
B. electronic oscillating circuits
C. light
D. accelerating charge

52. The magnitude of the induced electric field around a changing magnetic flux

52. A. varies inversely as the distance from the flux
B. varies inversely as the square of the distance from the flux
C. is independent of the distance from the flux
D. varies inversely as the square root of the distance from the flux

FOR ROUGH WORK

(No marks given for work in this space)

Values

In answering the following problems, show your solutions in logical steps. When diagrams are drawn to scale, the scale used should be clearly indicated.

53. A boy on a bicycle starts from rest and coasts down a long hill accelerating uniformly at the rate of 0.60 m/sec/sec.

2 (a) How far does he go during the first 5.0 sec after he starts?

2 (b) How far does he move from his starting position by the time he attains a speed of 20 m/sec?

FOR ROUGH WORK

(No marks given for work in this space)

Values

2 **54.** A man is walking at 4.0 mph in a direction 30° east of north. What is the magnitude of his northward component of motion?

FOR ROUGH WORK

(No marks given for work in this space)

Values

55. A body is projected upwards at an angle of 30° above the horizontal from the edge of the roof of a high building. The initial speed of the body is 40 m/sec. It strikes the horizontal surface at ground level 6.0 sec after projection. Neglecting air resistance, calculate:

3 (a) the maximum height reached by the body

4 (b) the height of the building

2 (c) the horizontal distance from the landing point to the foot of the building.

FOR ROUGH WORK

(No marks given for work in this space)

Values

8 **56.** A white billiard ball moving across the table at 4.0 m/sec strikes a stationary red billiard ball. After the collision the white ball is moving 30° east of north at 2.5 m/sec; the red ball is moving at 3.0 m/sec. Assuming the balls are of equal mass and size, find a possible original direction of motion of the white ball.

FOR ROUGH WORK

(No marks given for work in this space)

Values

4 **57.** A simple pendulum is 1.0 m long and has a bob of mass 0.01 kg. During one particular oscillation the bob is observed to rise to a position 0.10 m vertically higher than the lowest point of the swing. Calculate the maximum velocity during that oscillation.

4 **58.** A certain spring bumper has a force constant of 400 newtons per meter. A cart of mass 0.25 kg moving at 10 m/sec runs into the bumper. How far will the spring compress before the cart is brought to rest?

FOR ROUGH WORK

(No marks given for work in this space)

Values

4 **59.** How many calories of heat will be produced in a heating element in one minute if a current of 7.0 amps passes through it while the potential difference between the ends of the element is maintained at 12 volts?

3 **60.** What is the maximum number of hydrogen atoms that can be deposited at the negative electrode of an electrolytic cell through which a current of 1.6 amps flows for 5.0 minutes?

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(No marks given for work in this space)

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